Remarks

1.   Abstract

In the Office Action dated August 5, 2003, the Abstract was objected to as not being in the proper form, specifically, as having fewer than 50 words. The Applicant has amended the Abstract to proper form.

2.   Status of the Claims

Claims 1-14, 16-18 and 20 remain pending in the application. Claims 1, 4, 7, 10, 13 and 20 are independent. Claims 1-12 stand allowed. Claims 13, 14, 16-18 and 20 stand rejected as anticipated by Baeten et al. (U.S. Patent No. 6,519,205 B1).

3.   Claim Rejections – 35 U.S.C. § 102(e)

The Applicant would like to thank the Examiner for his careful review of remarks filed in response to the previous Office Action dated February 3, 2003. The Applicant would particularly like to thank the Examiner for allowing claims 1-12. Claims 13, 14, 16-18 and 20 stand rejected as anticipated by Baeten et al. (U.S. Patent No. 6,519,205 B1). The Applicant respectfully traverses the rejection for the following reasons.

The Applicant's invention relates to methods for identifying primary events in seismic data, and separating them from non-primary events, such as multiple reflections and ghosts that are common in marine seismic data. Claim 13 recites a particular method for identifying primary events in seismic data, comprising:

> a) sorting the seismic data according to frequency;
> b) applying a coherency filter to the seismic data; and
> c) selectively attenuating events in the seismic data,
> wherein the selectively attenuating is dependent upon the
> frequency and coherency of events identified by the
> coherency filtering.

In a method according to claim 13, a coherency filter is applied to frequency-sorted seismic data. The coherency filtered data are then selectively attenuated according to the frequency and coherency of events determined from the coherency filtering. The result in various embodiments is a seismic data set from which primary events have been identified.

3

The first point is that Baeten et al. does not disclose applying a coherence filter to frequency-sorted seismic data. The disclosure in Baeten et al. relates to methods for attenuating "ground roll" in seismic data. Ground roll is a phenomenon detected during seismic data recording that is related to seismic energy propagating substantially directly along the surface of the earth from the seismic energy source to the seismic sensors. Methods according to Baeten et al. include determining a ground roll "move-out." Move out is a time shift between seismic signals received at different seismic sensors related to the velocity of the seismic energy through the earth formations and the different lengths of seismic energy travel path between the source and each of the sensors. A time correction may be applied to seismic data to correct for the length of the travel path of seismic energy from the source to each particular sensor in an array or group of sensors. The amount of time correction applied to signals from a particular sensor to correct for move out thus depends on the travel path length and the velocity of seismic energy in the earth between the source and the particular sensor. Therefore, move out correction requires estimating the velocity of the seismic energy.

In the cited portion of Baeten et al., the ground roll velocity estimates used to determine the ground roll move out can be improved by making the velocities used for the move out correction be frequency dependent. The portion of Baeten et al. cited as anticipating claim 13 is related to such methods for making dispersive (frequency dependent) ground roll velocity. The portion cited in Baeten et al. reads as follows:

> a) dividing the data into time windows and frequency
> bands;
> b) for each frequency band, examining a range of
> velocities;
> c) applying a linear move-out on the data using a particular
> velocity;
> d) testing all velocities in the range;
> e) selecting the particular velocity that yields the highest
> coherence between the traces; and
> f) completing the examination for each of the frequency
> bands.

At first glance, there may appear to be some similarities to the cited portion of Baeten et al. and the Applicant's claim 13. Seismic data are sorted into frequency bands or

4

according to frequency. Here the similarities between Applicant's claim 13 and the disclosure in Baeten et al. end. Baeten et al, recites that within each frequency band, a range of [ground roll] velocities is tested. For each tested velocity, a linear move out is applied to the seismic data. The velocity which results in the highest coherence between traces is then selected as the particular move out (ground roll) velocity for that particular frequency band. Applying a selected-velocity move out to data and then determining coherence between traces as recited in Baeten et al. is not the same as "coherency filtering" as recited in Applicant's claim 13 as will be explained below. "Coherency filtering", as recited in the Applicant's claimed invention, is applied to the frequency sorted traces and passes-through (conducts to the filter output) portions of the frequency sorted seismic traces which are coherent from trace to trace. Coherency filtering also excludes or attenuates, with respect to the output of the filter, portions of the input seismic traces which are not coherent from trace to trace. Coherency filtering thus enables determining events in seismic traces which are similar with respect to a particular reference. Determining the "highest coherence", as recited in Baeten et al, however, only determines the overall degree of similarity between respective seismic traces. Determining coherence only provides as output a numerical or similar representation of the degree of similarity of one trace to another. As used in the method disclosed in Baeten et al., various ground roll velocities are tested within each frequency band, and the velocity which provides the highest degree of similarity (coherence) between traces having move out correction applied is selected as the velocity of the ground roll signal at the particular frequency. Coherency filtering as recited in Applicant's claim 13 is applied to frequency sorted seismic data without regard to move out, although move out correction may be applied to the traces in some embodiments. There is no output in the testing and selecting as disclosed in Baeten et al. that corresponds to the output of coherency filtered seismic traces as recited in Applicant's claim 13, wherein non-primary events are separated from primary events. Therefore, at least one element of Applicant's claim 13 is not shown in Baeten et al.

Applicant's claim 13 also recites "selectively attenuating events in the seismic data, the selective attenuating dependent on coherency and frequency of events identified by the coherency filtering." As explained above with respect to the difference between

5

"determining a highest coherence" and "coherency filtering", to the extent the disclosure in Baeten et al. refers to selective attenuation, such selective attenuation is not dependent on frequency and coherency of events identified by coherency filtering, because methods disclosed in Baeten et al. do not include coherency filtering that identifies coherent events. As understood by those skilled in the art, "events" in seismic data interpretation refers to particular seismic signal amplitude indications that may be present in a number of seismic traces each representing a different travel path from source to sensor. Events may correspond to a seismically reflective horizon beneath the surface, or some other seismic anomaly. Baeten et al. discloses attenuation of certain portions of seismic traces, for example at col. 5, lines 25-28, but the "attenuation" disclosed in Baeten et al. is produced by subtracting a ground roll signal estimate from seismic traces to produce ground roll attenuated traces. Note, however, that the attenuating disclosed in Baeten et al. is not dependent on frequency or coherency of events determined by coherency filtering. Therefore, at least one more limitation of claim 13 is not shown or fairly implied by Baeten et al. The Applicant therefore believes that claim 13 is not anticipated or made obvious by Baeten et al. Claim 13 is believed to be patentable over the art of record.

Claims 14 and 16-18 ultimately depend from claim 13 and are patentable for at least the same reasons advanced with respect to claim 13.

Claim 20 recites a system for identifying primary events in seismic data. A system according to claim 20 includes means for performing each of the method elements recited in claim 13. Claim 20 is therefore patentable for at least the same reasons advanced with respect to claim 13.

The Applicant believes that this Reply is fully responsive to each and every ground of rejection cited in the Office Action dated August 5, 2003, and respectfully requests early favorable action on this application.

Respectfully submitted,

Date: 9/19/2003
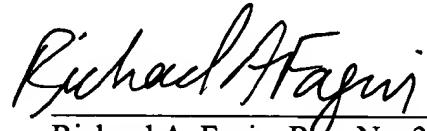
Richard A. Fagin, Reg. No. 39,182
11607 Glen Knoll Ct.
Houston, TX 77077

Attorney of Record
E. Eugene Thigpen, Reg. No. 27,400
Petroleum Geo Services, Inc.
738 Highway 6 South, Suite 500
Houston, TX 77079
Telephone: (281) 679-2288
Facsimile: (281) 589-1482